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RESPONSE OF DAIRY COWS TO CORN AND GRAIN SORGHUM FED AS SOILAGE AND SILAGE

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INTRODUCTION

Continued research to improve existing crops and the development of new crop varieties necessitates the evaluation of such crops in terms of livestock performance.

A number of varieties of corn and sorghum have been developed in recent years. Generally, where equal tonnages of corn and forage sorghum silage can be produced, the preference is to use corn silage because of its slightly greater nutritional value (11). Forage sorghums have more heat and drought tolerance than corn, making them adaptable to the warm semi-arid sections of the United States. Consequently, where moisture is a limiting factor, forage sorghums have yielded much more than corn.

Hybrid forage sorghum varieties and bird-resistant grain-type sorghums capable of producing high yields of both grain and forage have been developed. Such varieties have been shown to approach the feeding value of corn and could possibly provide a greater yield of total digestible nutrients per acre than the common varieties of sorghum or even some varieties of corn. Niehaus (10) has recently reported high grain yields for several sorghums grown in northeast and north central Ohio.

In general, conclusions have been that forage-type grain sorghums do not support a level of milk production as high as that obtained with corn silages (5, 9, 11, 12), that combine-type sorghum is apparently equal to corn silage in supporting average levels of milk production (12,980 to 14,080 lb. per 305-day lactation) (1, 2, 15), that the digestibility of sorghums is lower than the digestibility of well-eared corn silage (3, 9, 11, 15), and that with the maturation of sorghum and corn plants, the digestion coefficient decreased (6, 8, 12, 14). On the contrary, Huffman and Duncan (7) and Perry *et al.* (13) found no significant effects of corn maturation on its digestibility.

With further research, it will be possible to determine whether the new forage sorghum hybrids available in Ohio are as productive and nutritious as corn varieties.

To obtain information on the value of sorghum as a forage for green chop and silage feeding, studies were undertaken at the OARDC North

Central Branch, Castalia, using lactating Holstein-Friesian cows. The objectives were:

- To determine the acceptability of locally grown bird-resistant grain sorghums in dairy cow rations.
- To compare the effects of chopped and ensiled grain-type sorghum and corn on milk production.
- To compare the digestibility of corn and sorghum silage when fed with and without concentrates.

EXPERIMENTAL PROCEDURE

Combine-type grain sorghum, RS-610, and protected and unprotected corn were used as silage and soilage. Sorghum and corn were direct-cut when the whole plant contained about 32 percent dry matter. A silo was half-filled with protected corn and the remaining half was filled with bird-damaged corn. The sorghum was ensiled between Oct. 7 and Oct. 10, bird-damaged corn between Sept. 14 and Sept. 19, and corn protected with various exploding devices between Sept. 19 and Sept. 25.

Soilage Feeding

The experiment was started Sept. 1, 1967. Lactating cows were fed experimental rations by housing groups—a stanchion group (18 cows) and a parlor group (15 cows).

Once-daily cuttings were made of corn and sorghum and fed as green chop in a single switchback trial. The cows were switched Sept. 16 and the experiment was terminated Oct. 10, 1967. In addition to soilage, the cows were fed concentrate at the rate of 1 lb. per 3 lb. of 4 percent fat-corrected milk (FCM) per day. The refuse was weighed back daily.

Digestion Trial

Throughout the course of these cuttings, 225 lb. samples of corn and sorghum plants were prepared daily in separate double plastic bags as ensilage for later digestion trials. Before sealing the plastic bags, the air was evacuated.

Two groups of three Jersey cows each were used. The corn and sorghum silages were fed with 0, 6 lb., and 18 lb. of concentrate mix (16 percent crude protein) to the cows of each group. This 13-day digestion trial was designed to study the changes in digestibility with maturity and the acceptability of the forage by the cows.

Silage Experiment

The cows were divided into the same two groups but only those cows which milked through the feeding period were used. The silage feeding

TABLE 1.—Sequence Used for Feeding Groups of Cows in Switchback Trials for Silage Feeding.

	Period 1	Period 2	Period 3
Dates of Experiment	Dec. 15-Jan. 14	Jan 15-Feb. 14	Feb. 15-Mar. 6
Damaged Corn Silage	Parlor cows	Stanchion cows	Parlor cows
Sorghum Silage	Stanchion cows	Parlor cows	Stanchion cows

trial was conducted between Oct. 11, 1967, and March 6, 1968, with 10 cows in the stanchion group and 8 in the parlor group.

Protected corn silage was fed in a direct comparision to sorghum silage for a 15-day test period following a 30-day preliminary period. Then a switchback trial for unprotected corn silage and sorghum silage with three 15-day periods was conducted as shown in Table 1.

The silage was fed at the approximate rate of 50 percent of the total dry matter intake. In addition, 7 to 9 lb. of alfalfa or alfalfa-brome hay was fed to each cow daily. The concentrates were fed in accordance with productivity of individual cows in amounts up to 30 lb. daily.

Records and Chemical Determinations

Daily milk weights were recorded and semi-monthly samples were obtained for milk fat. Samples of feed were obtained periodically for dry matter and nitrogen analysis.

RESULTS

Effects of Maturity on Digestibility

In general, the digestibility of sorghum was less than that of corn. Changes in digestibility with increasing maturation of forage are shown by "no grain" fed cows in Figure 1.

Initially, the corn was 67.8 percent digestible and sorghum was 62.0 percent. Digestibility was 59.2 percent and 57.4 percent for the corn and sorghum respectively on the last day. The results of the 13-day digestion trial are presented in Table 2.

The mean values of corn with respect to percent digestibility, total dry matter intake, and digestible dry matter intake were 70.2 percent, 19.8 lb., and 14.3 lb. The values for sorghum were 61.6 percent, 21.3 lb., and 13.2 lb., respectively.

The data were analyzed in a 3 x 2 factorial design. The effects of grain and silages on digestibility were highly significant ($P < .01$) but their interaction was not significant. On the other hand, in the case of total dry matter intake and digestible dry matter intake, the effects of grain and silage and their interactions were all significant except that of silage for digestible DM intake. When 18.0 lb. of grain

TABLE 2.—Corn Silage Was More Digestible Than Sorghum Silage When Fed With and Without Grain in Digestion Trials.

	Corn			Sorghum		
Amount of Grain per Day (lb.)	0.0	6.0	18.0	0.0	6.0	18.0
Percent Digested	66.9	71.3	72.6	59.7	61.2	63.8
Total DM Intake (lb.)	10.4	21.3	28.0	13.8	20.2	29.9
Dig. DM Intake (lb.)	7.0	15.3	22.2	8.3	12.3	19.2
Body Wt. of Cows (lb.)	801.0	956.2	998.0	855.3	1122.2	870.4
Dig. DM Intake per 1000 Lb. Body Wt. (lb.)	8.8	15.9	20.5	9.7	11.1	22.0
Pounds of Concentrate Fed per 1000 Lb. Body Wt.	0.0	6.3	18.1	0.0	5.4	20.7

was fed with sorghum silage, the effect of low digestibility seemed to be overcome.

There was a tendency for cows to produce more when fed corn in comparison with sorghum but the results were not significantly different in any case. In the green chop experiment, the least square means of milk production from corn and sorghum soilage were 40.0 lb. and 38.7 lb., respectively. The average results for milk production are given in Table 3.

The protected corn silage resulted in more actual milk than sorghum silage (Table 4). On the other hand, after accounting for the effects of preliminary milk production, the differences between corn and sorghum silage 4 percent FCM production were found to be non-significant. Further details of the experimental results are given in Table 4.

Likewise, with unprotected corn silage vs. sorghum silage, the difference between the actual milk production of cows fed corn or sorghum

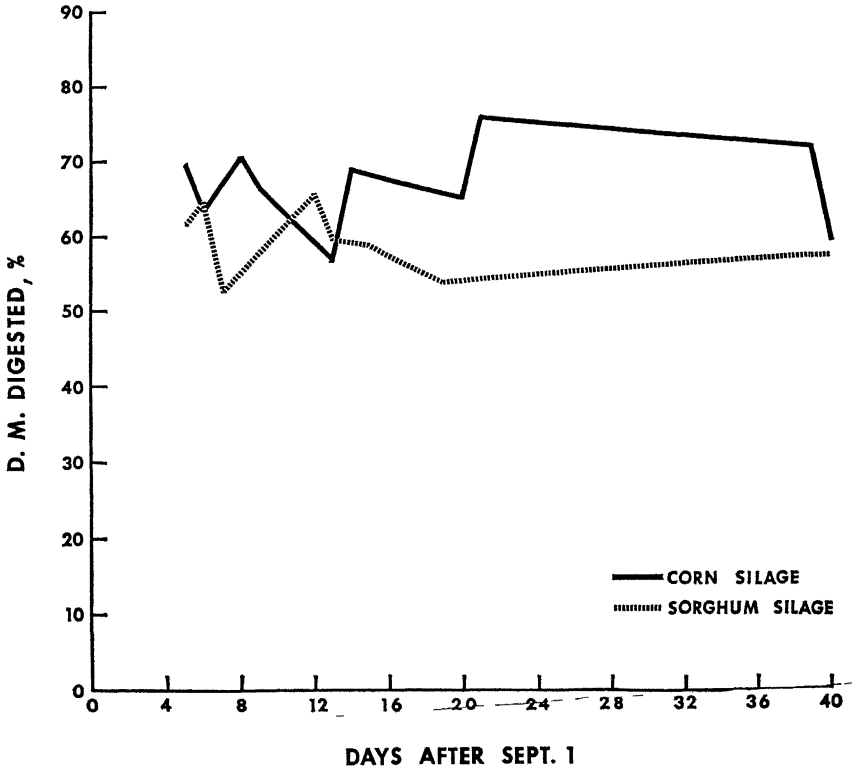

Fig. 1.—Corn and sorghum silage digestibility as affected by the maturity of plants.

TABLE 3.—Cows Produced Well When Fed Green Chopped Corn or Sorghum in a Switchback Trial (4 Percent Fat Corrected Milk).

Group	Crop	Period	Means	Least Square Mean*
			lb.	lb.
Stanchion	Corn	1	43.8	43.7
	Sorghum	2	38.9	36.7
Parlor	Corn	2	36.2	38.2
	Sorghum	1	38.6	40.6
Groups Combined	Corn			40.0
	Sorghum			38.7

*After adjusting for milk production in the preliminary period.

TABLE 4.—Milk Production Was Highest in Cows Fed Corn Silage Compared with Cows Fed Sorghum Silage.

Group	Crop	Actual Milk	4% FCM
		lb./day	lb./day
Stanchion	Corn	57.8	53.2
Parlor	Sorghum	49.5	49.4

TABLE 5.—Unprotected Corn Silage Resulted in Slightly Better Milk Production Than Sorghum Silage.

Group	Period	Silage	Actual Milk	4% FCM
			lb./day	lb./day
Stanchion	1	Sorghum	50.8	49.3
Stanchion	2	Corn	50.2	47.8
Stanchion	3	Sorghum	45.6	43.2
Parlor	1	Corn	46.7	41.4
Parlor	2	Sorghum	43.4	40.8
Parlor	3	Corn	45.0	42.7

silage was significant but 4 percent FCM was not. Results of the double reversal trial are presented in Table 5.

It was concluded that the difference in response of 4 percent FCM and actual milk production resulted from the change in fat yield lagging total milk yield in the short period of observation. Average feed intake of all cows, including non-testers, eating corn or sorghum silage is presented in Table 6.

DISCUSSION

Digestibility of sorghum was lower than that of corn. Workers at other research stations (3, 12, 15) have also reported such results except Browning *et al.* (2) when they fed high amounts of concentrate along with sorghum.

In these Ohio results, the level of digestibility of sorghum was reduced but the amount of digestible dry matter eaten per pound of body weight became equal and adequate when the cows were fed 18 lb. of concentrate daily (Table 2). In the feeding trials with silage, the level of actual milk production was higher in corn than in sorghum fed groups.

Haenlein and Richard (5), Lance *et al.* (9), Owen *et al.* (12) and Zogg *et al.* (16) all reported more milk production from cows fed corn silage compared with sorghum.

These Ohio results suggest that at low levels of milk production, sorghum is as good as corn. However, in high-producing cows, the sorghum is not as good as corn roughage in meeting their nutritional or metabolic requirements. Extra grain feeding would help overcome the effect of the relatively low digestibility of sorghum.

CONCLUSIONS

From these results, it is concluded that:

- The digestibility of sorghum was less than that of corn.
- Corn fed as green chop or corn silage produced more milk than when sorghum was fed.
- The effects on feed intake of low digestibility of sorghum could be overcome by feeding a sufficient quantity of concentrates (21 lb. of concentrate per day per 1000 lb. of body weight).

TABLE 6.—Average Feed Intake by Period and by Housing Group.*

Period	Group	Grain Mix	Hay	Sorghum Silage	Protected Corn Silage	Unprotected Corn Silage
		(lb./cow/day)				
I. Nov. 15 to	Stanchion	16.7	7.7	—	97.5	—
Dec. 14	Parlor	16.2	7.4	93.5	—	—
II. Dec. 15 to	Stanchion	16.6	6.1	81.2	—	—
Jan. 14	Parlor	16.2	7.1	—	100.1	85.6
III. Jan. 15 to	Stanchion	18.4	7.0	—	—	71.8
Feb. 14	Parlor	16.5	7.7	88.7	—	—
IV. Feb. 15 to	Stanchion	18.9	5.9	72.6	—	—
Mar. 6	Parlor	17.4	5.6	—	—	73.3

*The average dry matter content was: grain, 92.4%; hay, 87.0%; sorghum silage, 26.9%; protected corn silage, 25.5%; and unprotected corn silage, 27.0%.

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